

CLAIMS

1. An electrode arrangement for a surgical instrument for electrothermal coagulation in tissue, comprising:

a front cylinder at the distal end of the instrument with a distal tip, an elongate, electrically insulating carrier proximally adjoining the front cylinder, at least two spaced electrodes on the carrier, which are connectable to an AC voltage source, characterized in that the electrodes are of a strip-shaped configuration and extend along the carrier.
2. An electrode arrangement for a surgical instrument according to claim 1 wherein the electrodes extend parallel to the longitudinal axis of the carrier.
3. An electrode arrangement for a surgical instrument according to claim 1 wherein the carrier is of a uniform cross-section in the longitudinal direction and wherein the electrodes are disposed in mutually diametrically opposite relationship on the carrier cross-section.
4. An electrode arrangement for a surgical instrument according to claim 1 wherein the electrodes extend on the carrier along spaced helical lines.
5. An electrode arrangement for a surgical instrument as set forth in claim 1 wherein the carrier is in the form of a metal tube with an externally disposed insulating coating.
6. An electrode arrangement for a surgical instrument according to claim 5 wherein the metal tube includes an outer layer of titanium or aluminum which at its surface carries a Ti-oxide layer or an Al-oxide layer as an insulating layer.
7. An electrode arrangement for a surgical instrument according to claim 1 further comprising a hollow duct in the longitudinal direction of the carrier, through which an optical waveguide passes.

8. An electrode arrangement for a surgical instrument according to claim 1 wherein the tip of the front cylinder is of a conical configuration.
9. An electrode arrangement for a surgical instrument according to claim 1 wherein the tip of the front cylinder is of a wedge-shaped configuration.
10. An electrode arrangement for a surgical instrument according to claim 1 wherein the electrodes are applied to the carrier in the form of thin conductive layers.
11. An electrode arrangement for a surgical instrument according to claim 1 wherein the carrier comprises flexible material.
12. An electrode arrangement for a surgical instrument according to claim 11 wherein the carrier is an optical waveguide, on the insulating outside sheath of which the electrodes are applied in a strip configuration an elastically.
13. An electrode arrangement for a surgical instrument according to claim 1 wherein the carrier comprises rigid material.
14. An electrode arrangement for a surgical instrument for electrothermal coagulation in tissue, comprising:
 - a) a front cylinder at the distal end of the instrument;
 - b) an elongate carrier proximally adjoining the front cylinder;
 - c) two electrodes which extend in the longitudinal direction of the carrier and which are connectable to an AC voltage source;

wherein the carrier includes externally disposed, self-supporting metal bar profile members which extend in the longitudinal direction and which are connected together by means of one or more insulating spacer elements and form the electrodes.

15. An electrode arrangement for a surgical instrument according to claim 14 wherein the optical waveguide is passed in the longitudinal direction between the bar profile members, as a spacer element.
16. An electrode arrangement for a surgical instrument according to claim 15 wherein the optical waveguides extend laterally visibly between the bar profile members.
17. An electrode arrangement for a surgical instrument according to claim 14 wherein the cross-section of the bar profile members corresponds to the segment of a circular area.
18. An electrode arrangement for a surgical instrument according to claim 14 wherein the cross-section of the bar profile members which are uniform in the longitudinal direction corresponds to a peripheral portion of a tube.
19. An electrode arrangement for a surgical instrument according to claim 18 wherein the bar profile members are disposed in mutually opposite relationship on the outside sheath of an optical waveguide.
20. An electrode arrangement for a surgical instrument for electrothermal coagulation in tissue, including
 - a) a front cylinder at the distal end of the instrument;
 - b) at least one elongate, electrically insulating carrier proximally behind the front cylinder;
 - c) two spaced cylindrical electrodes;
 - d) a hollow duct in the longitudinal direction through the carrier; and
 - e) connecting lines which are passed through the hollow duct for connecting the electrodes to an AC voltage source;

wherein the electrodes are cylindrical tube portions of metal which are arranged at a predetermined spacing from each other in the longitudinal direction in axial alignment with the carrier.

21. An electrode arrangement for a surgical instrument according to claim 20 wherein the carrier is a flexible tube of insulating material.
22. An electrode arrangement for a surgical instrument according to claim 20 further comprising a central opening in the front cylinder provided as a prolongation of the hollow duct, said central opening having arranged therein a temperature sensor whose connecting line is taken out through the hollow duct to the proximal end of the instrument.
23. An electrode arrangement for a surgical instrument according to claim 20 wherein the outside diameter of the front cylinder approximately corresponds to the outside diameter of the electrodes.
24. An electrode arrangement for a surgical instrument according to claim 20 wherein the axial length of the electrodes is larger than their diameter.
25. An electrode arrangement for a surgical instrument according to claim 20 wherein the axial length of the electrodes is larger than double their diameter.
26. An electrode arrangement for a surgical instrument according to claim 20 wherein the spacing of the two electrodes is approximately equal to or smaller than the outside diameter of the electrodes.
27. An electrode arrangement for a surgical instrument according to claim 20 wherein the distal front cylinder includes insulating material or metal.
28. An electrode arrangement for a surgical instrument according to claim 20 wherein the temperature sensor in the opening in the front cylinder is embedded in a synthetic resin or adhesive bed.

29. An electrode arrangement for a surgical instrument according to claim 28 wherein the outside diameter of the electrodes corresponds to the outside diameter of the front cylinder and wherein the intermediate space between the electrodes is filled by insulating material to the outside diameter of the electrodes.
30. An electrode arrangement for a surgical instrument according to claim 20 wherein the first electrode axially extends in the distal direction a predetermined length over the front cylinder.
31. An electrode arrangement for a surgical instrument according to claim 20 wherein the electrodes are formed from self-supporting metal tube portions.
32. An electrode arrangement for a surgical instrument according to claim 31 wherein the first electrode is arranged between the front cylinder and an insulating tubular first carrier, the second electrode is arranged between the first carrier and an insulating tubular second carrier, and wherein the electrodes rest with their end portions on the front cylinder, and the first and second carriers.
33. An electrode arrangement for a surgical instrument according to claim 20 wherein the first electrode extends between the front cylinder and the insulating tubular carrier and the second electrode extends from the carrier to the proximal end portion, and wherein the electrodes bear with their end portions on the front cylinder and the carrier.
34. An electrode arrangement for a surgical instrument according to claim 33 wherein the second electrode is proximally covered over a predetermined axial length with an insulating layer.
35. An electrode arrangement for a surgical instrument according to claim 20 further comprising a flushing tube within the hollow duct, which extends from the proximal end of the instrument to the front cylinder and discharges fluid at its distal end into the hollow duct in which the fluid flows back to the proximal end of the instrument.

36. An electrode arrangement for a surgical instrument according to claim 20 wherein the end portions of the electrodes, which overlap the front cylinder and the carrier or carriers, are covered on their outer periphery by an insulating layer.
37. An electrode arrangement for a surgical instrument according to claim 20 wherein the tip of the front cylinder is of a conical or wedge-shaped or rounded-off configuration.
38. An electrode arrangement for a surgical instrument according to claim 20 further comprising a self-supporting metal tube between the front cylinder and the carrier, with a distal tube portion and a proximal tube portion, a cylindrical insulating layer on the proximal tube portion and a cylindrical metal layer at the proximal end of the insulating layer, wherein the distal tube portion forms the first electrode and the proximal metal layer forms the second electrode.
39. An electrode arrangement for a surgical instrument according to claim 20 further comprising a self-supporting metal tube between the front cylinder and the carrier, with a distal tube portion and a proximal tube portion, a cylindrical insulating layer on the distal tube portion and a cylindrical metal layer at the distal end of the insulating layer, wherein the distal metal layer forms the first electrode and the proximal tube portion forms the second electrode.
40. An electrode arrangement for a surgical instrument according to claim 20 wherein the carrier has a hollow duct which goes into the hollow duct of the metal tube or the tube portions, and wherein the connecting lines for the electrodes are passed through the hollow duct of the carrier to the proximal end of the instrument.
41. An electrode arrangement for a surgical instrument according to claim 20 further comprising a flushing tube passing through the hollow duct of the carrier and the metal tube or the tube portions in the longitudinal direction, said flushing tube extending to the front cylinder, through which flushing tube fluid is discharged at the distal end into the hollow duct, which outside the flushing tube is in contact with

the metal tube flows back through the hollow duct of the tube and the hollow duct of the carrier to the proximal end of the instrument.

42. An electrode arrangement for a surgical instrument according to claim 38 further comprising an insulating inner tube in the hollow duct of the carrier and the metal tube, through which a connecting line for the electrode at the distal end of the tube is passed.
43. An electrode arrangement for a surgical instrument according to claim 38 wherein the front cylinder comprises insulating material.
44. An electrode arrangement for a surgical instrument according to claim 38 wherein the metal tube comprises aluminum or titanium and that the insulating layer is formed from the metal tube of aluminum oxide or titanium oxide.
45. An electrode arrangement for a surgical instrument for electrothermal coagulation in tissue, comprising:
 - a) a front cylinder of metal at the distal end of the instrument;
 - b) an elongate cylindrical carrier of insulating material proximally adjoining the cylinder; and
 - c) two spaced cylindrical electrodes;

wherein the metal front cylinder is rounded off at the distal end and adjoining the round end portion has a cylinder portion of predetermined length, wherein the front cylinder forms the first electrode and wherein disposed on the carrier at a predetermined axial spacing from the front cylinder is a metal layer as the second electrode.

46. An electrode arrangement for a surgical instrument according to claim 45 further comprising a hollow duct provided through the carrier and the front cylinder to the round end portion a flushing tube extending through said hollow duct and which,

at the distal end, discharges fluid which flows back in the hollow duct - outside the flushing tube - to the proximal end.

47. An electrode arrangement for a surgical instrument according to claim 45 wherein the front cylinder can be secured with its proximal end in an annular opening of the carrier and that an oxide layer is externally applied to the metal front cylinder in the overlap region between the carrier and the front cylinder.
48. An electrode arrangement for a surgical instrument according to claim 20 wherein the axial length of the electrodes is greater than the axial spacing of the two electrodes from each other.
49. An electrode arrangement for a surgical instrument according to claim 20 characterized in the axial length of the electrodes is greater than the diameter of the electrodes.
50. An electrode arrangement for a surgical instrument according to claim 20 characterized in that the axial length of the electrodes is greater than the axial length of the lengthwise portion occupied by the insulator element.
51. An electrode arrangement for a surgical instrument according to claim 20 wherein the axial length of the electrodes is greater than the outside diameter of the front cylinder or the outer conductor respectively.
52. An electrode arrangement for a surgical instrument according to claim 20 wherein the axial spacing of the electrodes from each other is approximately equal to or smaller than the outside diameter of the front cylinder.
53. An electrode arrangement for a surgical instrument according to claim 20 wherein the self-supporting metal tube or tube portions and/or the metal cylinder body which are provided to form the electrodes comprise titanium or aluminum and that the insulating layers which are provided on the metal tube or the metal tube portions are applied by anodic oxidation of the metal surface in an electrolyte bath.

54. An electrode arrangement for a surgical instrument according to claim 20 wherein at least one of the connecting lines for connection of the electrodes has at one end a portion of spring metal which is clamped radially outwardly in the hollow duct against the inside surfaces of the electrodes.